AGU Fall Meeting
Invited Talk
Session Id: 1809
Session Title: Identifying and Better Understanding Data Science Activities, Experiences, Challenges, and Gaps Areas

Data-Intensive Science meets Inquiry-Driven Pedagogy: Interactive Big Data Exploration, Threshold Concepts, and Liminality

Rahul Ramachandran, *GHRC NASA/MSFC*
Andrea Word, and Udaysankar Nair, *University of Alabama in Huntsville*

Threshold concepts in any discipline are the core concepts an individual must understand in order to master a discipline. By their very nature, these concepts are troublesome, irreversible, integrative, bounded, discursive, and reconstitutive. Although grasping threshold concepts can be extremely challenging for each learner as s/he moves through stages of cognitive development relative to a given discipline, the learner's grasp of these concepts determines the extent to which s/he is prepared to work competently and creatively within the field itself. The movement of individuals from a state of ignorance of these core concepts to one of mastery occurs not along a linear path but in iterative cycles of knowledge creation and adjustment in liminal spaces – conceptual spaces through which learners move from the vaguest awareness of concepts to mastery, accompanied by understanding of their relevance, connectivity, and usefulness relative to questions and constructs in a given discipline. For example, challenges in the teaching and learning of atmospheric science can be traced to threshold concepts in fluid dynamics. In particular, Dynamic Meteorology is one of the most challenging courses for graduate students and undergraduates majoring in Atmospheric Science. Dynamic Meteorology introduces threshold concepts – those that prove troublesome for the majority of students but that are essential, associated with fundamental relationships between forces and motion in the atmosphere and requiring the application of basic classical statics, dynamics, and thermodynamic principles to the three dimensionally varying atmospheric structure.

With the explosive growth of data available in atmospheric science, driven largely by satellite Earth observations and high-resolution numerical simulations, paradigms such as that of data-intensive science have emerged. These paradigm shifts are based on the growing realization that current infrastructure, tools and processes will not allow us to analyze and fully utilize the complex and voluminous data that is being gathered. In this emerging paradigm, the scientific discovery process is driven by knowledge extracted from large volumes of data. In this presentation, we contend that this paradigm naturally lends to inquiry-driven pedagogy where knowledge is discovered through inductive engagement with large volumes of data rather than reached through traditional, deductive, hypothesis-driven analyses. In particular, data-intensive techniques married with an inductive methodology allow for exploration on a scale that is not possible in the traditional classroom with its typical problem sets and static, limited data samples. In addition, we identify existing gaps and possible solutions for addressing the infrastructure and tools as well as a pedagogical framework through which to implement this inductive approach.